Chemistry 129.01 Quiz #11

Name: _____

Show all your work!

1. (10 pts.) When a 9.55 g sample of solid sodium hydroxide dissolves in 100.0 g of water in a coffee-cup calorimeter, the temperature rises from 23.0 °C to 47.4 °C.

constant P calorimeter

$$NaOH_{(aq)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$$

How much heat is released by the solution process? Assume the specific heat of the solution is 4.184 J/(g . °C). Calculate the ΔH (in kJ/mol of NaOH) for the solution process.

$m_{soln} = 9.55\,g + 100.0\,g = \underline{109.55\,g}$

$\Delta T = 47.4\,^\circ C - 23.0\,^\circ C = 24.4\,^\circ C$

$q_{rxn} = -m_{soln} \times C_s \times \Delta T$

$= -\left(\underline{109.55\,g} \times 4.184 \frac{J}{g \cdot ^\circ C} \times 24.4\,^\circ C\right)$

$q_{rxn} = \underline{-11{,}183.9\,J} = \underline{-1.12 \times 10^4\,J} = \underline{-11.2\,kJ}$

$\text{moles NaOH} = 9.55\,g\,NaOH \left(\frac{1\,mol\,NaOH}{40.00\,g\,NaOH}\right) = \underline{0.23875}\,mol\,NaOH$

(a) constant P, $\Delta H = q_P$

$$\Delta H = \frac{-11.2\,kJ}{0.239\,mol} = -46.8\,\frac{kJ}{mol}$$

2. (10 pts) Given the following data

$N_{2(g)} + O_{2(g)} \rightarrow 2\ NO_{(g)}$ $\Delta H = +180.7kJ$

$2\ NO_{(g)} + O_{2(g)} \rightarrow 2\ NO_{2(g)}$ $\Delta H = -113.1kJ$

$2\ N_2O_{(g)} \rightarrow 2\ N_{2(g)} + O_{2(g)}$ $\Delta H = -163.2kJ$

use Hess's law to calculate ΔH for the following reaction:

$N_2O_{(g)} + NO_{2\,(g)} \rightarrow 3\ NO_{(g)}$

$N_2O \rightarrow N_2 + \frac{1}{2}O_2$ $\quad \Delta H = \frac{1}{2}(-163.2\ kJ)$

$NO_2 \rightarrow NO + \frac{1}{2}O_2$ $\quad \Delta H = \frac{1}{2}(113.1\ kJ)$

$N_2 + O_2 \rightarrow 2\ NO$ $\quad \Delta H = 180.7\ kJ$

$N_2O + NO_2 \rightarrow 3\ NO$ $\quad \Delta H = 155.7\ kJ$

3. (5pts) Determine the heat of reaction for the following reaction:

$CaCl_{2(s)} \rightarrow Ca^{2+}_{(aq)} + 2\ Cl^-_{(aq)}$

Is the reaction endothermic or exothermic? Why?

Substance:	ΔH_f°
$CaCl_2(s)$	-795.8kJ/mol
$Ca^{2+}(aq)$	-543.0kJ/mol
$Cl^-(aq)$	-167.2kJ/mol

$\Delta H_{Rx}^\circ = \Sigma n \Delta H_{f,prod}^\circ - \Sigma n \Delta H_{f,react}^\circ$

$= [(1\ mol \times -543.0\ kJ/mol) + (2\ mol \times -167.2\ kJ/mol)]$

$-(1\ mol \times -795.8\ kJ/mol)$

$\Delta H_{Rx}^\circ = -51.6\ kJ$